DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TABULAR TEXT--SURFICIAL GEOLOGY OF THE JUNEAU URBAN AREA AND VICINITY, ALASKA

By

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Geologic Unit	General lithologic description and age	Distribution and topographic form	Thickness	General physical properties	Workability	Drainage	Erodibility	Foundation stability	Probable ground response to a severe earthquake	Probable susceptibility to earthquake-induced water waves	Stability of natural and cut slopes	Susceptibility to encroachment by rockfalls	Use
[illegible] alluvium (Qal)	Variable; sand and pebble to boulder gravel; rock types include slate, greenstone, flow breccia, and granite Age is Holocene.	Forms broad plains and point bars along larger streams.	Variable, from a few inches to several feet.	Generally loose and saturated.	Excavation and drilling are easy; scrapers and graders can move most of the alluvium except for large boulders. Standing water likely in excavations.	Infiltration rapid; runoff fair to poor.	Easily eroded by lateral scour from streams.	Generally poor.	Thick and water-saturated deposits likely to fracture, compact, and eject sediment-laden water.	High to very low depending on altitude and nearness to large water body.	Generally poor; stability of cuts very poor, slumps likely.	Variable; generally low; deposits are far from steep slopes.	Good- to fair-quality fill and embankment material, select borrow Types I, II, and III.
Fan deposits (Qf)	Variable; sand and cobble to boulder gravel to cobbles and boulders; prominent rock types include slate, greenstone, and granite. Age is Holocene.	At mouths of most streams; fan shaped; generally smooth, slightly dissected surfaces with slopes of 5°-10°.	Variable, from less than 5 ft to at least 80 ft.	Loose in upper part, more compact below depths of 5-8 ft.	Easy to moderately difficult with light or heavy power equipment. Draglines can be used successfully below water table. Drill holes need to be cased.	Good; infiltration rapid to medium; runoff slow to rapid.	Highly susceptible to erosion by concentrated flows of water.	Fair to good.	Slight to intense depending in part on depth to water table; possible sand boils, spouts; ground fracturing, sliding of fan-delta fronts.	High to very low depending on location with respect to the delta portions of the fans and water level.	Generally good.	Low to high, depending on location relative to steep mountain slopes.	The granite-rich Fish Creek fan is a good source of material for embankments and concrete aggregate.
Terrace deposits (Qt)	Sand to cobble and boulder gravel. Age is late Holocene.	Form generally flat or gentle sloping surfaces adjacent to Gold, Lemon, Montana, Peterson, and Fish Creeks; locally forms two or more surfaces separated by low scarps.	Variable; from 2 to at least 8 ft exposed, but probably extend well below stream level.	Generally loose, uncompacted; saturated below water table, which is usually within 10 ft of surface.	Easily excavated and drilled.	Excellent infiltration; fair surface runoff.	Easily eroded by streams.	Generally good for light structures and roads.	Compaction and ground fracturing likely along Lemon Creek; minor slumping elsewhere.	Generally nil, but high at mouth of Lemon Creek.	Generally fair; slopes commonly stabilized at 30°-35° if undisturbed.	Generally moderate or low depending on nearness to steep mountain slopes.	Good source of fair- to good-quality sand and gravel; suitable especially for embankment or fill.
Rubble deposits (Qar)	Angular blocks, many 10-12 ft across, of locally derived slate, greenstone, and metavolcanics, and erratic granite boulders. Age probably Holocene.	Along bottoms of some ravines, and along some stream channels, as a jumbled mass.	Variable; probably less than 20 ft.	Rock fragments are in point-to-point contact; voids only partly filled by smaller rocks.	Difficult because of the jumbled character of the deposit and the 10-12-ft size of individual fragments.	Excellent infiltration and internal drainage.	Can be eroded only by torrential runoff.	Generally poor.	Individual rock fragments probably would shift and settle, and possibly would roll downslope.	Nil.	Poor, especially in slopes of excavations.	Generally not susceptible.	Possible source of good-quality riprap.
Younger delta deposits (Qdy)	Range from fine sand to sandy gravel. Age is Holocene.	At mouths of streams flowing from mainland and Douglas Island into Gastineau Channel and Fritz Cove. Upper surfaces slope gently and delta fronts slope about 25°.	Probably more than 50 ft.	Generally loose in upper part, but become more dense with depth; wet.	Generally easy to excavate and drill; dragline used successfully below water table.	High water tables restrict uniformly rapid rate of infiltration; runoff generally rapid as sheetwash or concentrated flow.	Easily eroded downward and laterally by flowing water.	Satisfactory for light structures placed away from front of delta. Overloading of saturated delta could cause differential compaction and differential settlement.	Probably would react strongly; massive slides expectable along delta fronts; compaction, ground fracturing, sand boils, and sand spouts likely; possible structural damage to buildings.	Extremely high.	Generally poor; slopes generally underwater except at very low tides; deposit saturated, and cuts permit seepage and possible slumps or earthflows.	Not affected by rockfalls.	Shell content restricts gravel to use as common fill.
Older delta deposits (Qdo)	Deltaic fossiliferous silty and clayey sandy gravel and gravelly sand, interlayered with hard, compact, cohesive diamicton layers that also contain marine shells. Age is late Pleistocene or early Holocene, or both.	At mouths of many streams along Gastineau Channel, at Auke Bay, and in the Montana Creek valley; generally have an evenly sloping surface that is locally dissected into several surfaces separated by scarps; extends as high as 500 ft above sea level.	Variable depending on size of delta; at least 30 ft thick in most places. Generally have small lateral extent.	Generally a loose sandy gravel or gravelly sand that contains scattered boulders. Dense diamictons that commonly are interbedded with the gravel have dry bulk densities of 140 pcf. Sample of a diamicton that crops out at the top of the delta near Eagle Creek has a bulk density of 150 pcf.	Sands and gravels are easily excavated, but the indurated diamictons are moderately difficult to remove with light power equipment.	Rapid infiltration in sand and gravel beds; slow infiltration where diamicton layers occur. Springs are common along base of deltaic deposits where they are underlain by impermeable materials.	Easily eroded by sheet wash and streams.	Generally good for light structures if they are placed no closer than 250 ft from edge of delta.	Probably would react selectively, such as by local compaction and differential settlement, fracturing, and slumping, and sliding near and along the faces of delta deposits.	Generally good; some marginal slopes show evidence of creep.	Nil.	Generally low; prehistoric rockfalls and landslides have covered parts of some of the deltas. The older delta deposits along Lemon Creek were covered by a slide, apparently from Heintzleman Ridge.	Possible source of good-quality gravel.
Modern beach deposits (Qby)	Fine sand to cobbles and boulders. Age is Holocene.	Along most shores; slopes average about 10° toward shoreline.	From a few inches where beach slope is mostly bedrock to more than 5 ft in bays and coves.	Generally loose and thin; local boulder accumulations.	Generally easily excavated to bedrock with power equipment; drilling easy except on boulder beaches.	Infiltration good through dry deposits; poor in saturated material. Runoff is excellent.	Beach deposits may be moved laterally or may be removed by wave erosion during storms; lesser lateral movement by shore currents.	Variable; poor in loose deposits more than 5 ft thick, excellent when structure is placed on underlying bedrock.	Shaking could cause differential movement on boulder beaches; thinly covered beaches would respond much as underlying bedrock.	High.	Good to excellent in most places; only in thickest deposits would shallow slumping and sand runs result where deposits are undercut by wave erosion.	Generally not affected by rockfalls; upslope surficial deposits may slide onto beach if piles of trees and materials from excavations are piled near edges of bluffs where overloading can result.	Bouldery deposits are fair source of riprap. Overprint on map depicts large accumulations.
Spit deposits (Qb)	Pebbly sand to sandy gravel, some boulders; rock types include slate, greenstone, flow breccia, and granite. Age is Holocene.	Sporadically along the shore and near mouths of streams; have elongate shape and asymmetrical slopes.	Variable; maximum about 16 ft.	Moderately compact to loose, water sorted and sifted. Rock pieces move and slide underfoot.	Most deposits are loose and easily excavated by light power equipment. Drilling is very easy except where boulders constitute part of the deposit.	In dry deposits, infiltration excellent and runoff poor. In saturated deposits, infiltration poor and runoff excellent.	Deposits slightly eroded by moderate waves and current; easily eroded by waves and currents related to storms and high high tides; locally eroded by lateral scour of streams.	Poor; has a high water table, and even where not saturated is moist and extremely unstable. Heavy loads probably will cause differential compaction.	Probably intense. A strong earthquake shock probably would cause fracturing, compaction, and perhaps water and sediment ejection as well as differential settlement, and some ravelling or slumping of slopes.	High. Spit deposits are likely to be inundated or eroded by tsunamis or other abnormal waves.	Good. Slopes generally stable. Artificial cuts or stream-eroded slopes probably will slump or ravel.	Nil; spits are far from mountain slopes.	Source of fair-quality gravel; some screening may be necessary. Generally small yardage; suitable for driveway gravel.
Young raised beach deposits (Qrb)	Brown to gray fine sand, gravel, and cobbles; mostly slate, some graywacke, greenstone, and flow breccia; bear a podzol soil. Age is late Holocene.	Tee Harbor, Lena Cove, near Outer Point, and on Spuhn Island; deposits have two topographic forms: narrow asymmetrical beach ridges, and broad relatively smooth surfaces that slope gently upward toward the land; extend about 20 ft above present sea level.	About 8-15 ft.	Generally loose; coarse fragments wedged together, with spaces filled with sand and silt and shell fragments.	Excavation and drilling generally easy.	Infiltration good; surface runoff slow.	Resists erosion by sheet wash but is susceptible to lateral scour by streams.	Deposits more than 10 ft thick are probably satisfactory for light buildings; looseness of deposit might permit shifting of fragments under weight of building.	Probably would react strongly to violent shaking; ground fracturing and differential settlement should be expected.	Very high.	Good; some ravelling of cut slopes.	Not within range of rockfalls.	Limited source of gravel of fair to good quality for nonspecification uses.
Older raised beach deposits (thin and continuous) (Qbe)	Dark-reddish-brown sand and pebble gravel. Pebbles are tabular. Spaces between pebbles are filled by sand and organic material. Age is late Pleistocene or early Holocene.	Along most shorelines and lower Montana Creek; veneers underlying deposits, and surface slopes 10°-15° away from mountainsides; extend to height of more than 600 ft above sea level.	Generally less than 5 ft, and commonly less than 3 ft.	Composed of loose platy fragments and tabular pebbles. Peat and sand fills open spaces; fragments easily displaced laterally.	Easily excavated with light power equipment; easily drilled.	Generally overlain by saturated muskeg, but infiltration moderately rapid; surface runoff slow where deposits exposed at surface. Seeps and springs occur at contact of beach gravels and underlying deposits.	Very slight where deposits are at surface and exposed to sheet wash; will ravel and gully where surface flow is concentrated along vertical faces.	Poor to fair for light structures.	Probably moderately susceptible to shaking; compaction, lateral displacements of individual fragments, and ravelling of exposed faces.	Nil, except for deposits along Auke Bay, Fritz Cove, and Lena Cove.	Stands well in vertical cuts, but cuts slowly ravel.	High where deposit is within 1/4 mile of steep mountainsides.	No known commercial use.
Older raised beach deposits (thick and local) (Qbo)	Pebbles, cobbles, and boulders in sandy matrix; slate, graywacke, greenstone, flow breccia, and granite are main rock types. Age is early Holocene.	In northern part of Juneau area. Some deposits are asymmetrical, having both steep and gentle slopes. Deposits extend to a maximum height of 200 ft above sea level.	Variable; generally at least 5 ft and locally more than 12 ft, as on Mendenhall Peninsula and near Lena Cove.	Generally well sorted; moderately loose granule and coarser gravel in which interstices are filled by sand and silt.	Generally easy to excavate, but difficult near Tee Harbor.	Excellent infiltration; poor surface runoff.	Slight from sheet wash, but high from concentrated flow; very coarse boulder deposits are not easily eroded.	Fair to good for light structures; heavy structures might settle differentially where underlying materials compact.	Probably would react to shaking by settling, locally fracturing, and minor ravelling and slumping along open faces.	Generally very low susceptibility except at south end of Tee Harbor and along Lena Cove.	Good in natural exposures; excavation slopes will ravel and slump.	Nil, except for deposits adjacent to steep mountain slopes along east side of Tee Harbor.	Good gravel resources; Lena Cove and Tee Harbor deposits have been exploited in past.
Intertidal deposits (Qts)	Dark-gray sandy silt, silty gravelly sand, and sandy gravel. Age is Holocene.	Extend along the shores and under shallow waters of fiords and bays; broad surfaces slope gently seaward.	Range from 3 ft to at least 20 ft.	Loose to moderately dense; saturated.	Generally easily excavated by hand tools and power equipment, draglines are used successfully below the water table; easily drilled.	Infiltration poor; surface runoff rapid.	Easily eroded.	Poor.	Probably intense; shaking, compacting, and breaking of ground; may spread laterally where overloaded by fill.	Very high.	Very poor to fair.	Nil.	Recreational; home for birds and ducks.
Emergent intertidal deposits (Qe)	Cohesive sandy silt containing some clay, plant roots, and shells. Locally mostly sand. Age is Holocene.	Near the mouths of principal streams; gently sloping surfaces; slightly eroded along runoff paths.	Generally less than 10 ft.	Predominantly silt, contain some sand and clay; saturated; low density.	Easily excavated with hand or power equipment; easily drilled; low bearing strength when wet. Frequent passage by heavy equipment over wet deposits can cause quagmires. Excavations commonly seep water.	Infiltration very slow; runoff moderately fast to rapid.	Easily eroded; runoff entrenched in dendritic drainageways.	Poor.	Probably intense; compaction, fracturing, and sand boils and sand spouts likely; lateral spreading possible as well as sliding where deposits overlie front of deltas.	High.	Fair slope stability because of cohesion within deposit.	Very low; not affected more than 1/4 mile from steep mountain slopes. Severe earthquake could send debris onto intertidal deposits locally.	Locally a source of good-quality sand, at depth, for road construction.
Glaciomarine deposits, first phase (Qmb)	Cohesive compact diamicton; an unsorted and unstratified mixture of sand, silt, gravel, and clay and pebbles, cobbles, and boulders with a silty sandy stony matrix; abundant marine molluscs and foraminifera; massive to crudely layered, it looks like till. Age, from radiocarbon dates, is older than 10,000 years B.P.	Along most channels, coves, bays, and streams, commonly to altitudes as high as 500 ft, and locally as much as 750 ft; surface slopes gently; commonly 10°-15°; underlies much of downtown Juneau.	Variable; from less than 20 ft to more than 60 ft.	Matrix principally sand, but moderately high in silt and clay content; plasticity index determined from 12 samples in 8 or less; liquid limits are as high as 22 percent, but the average of 13 samples is 19 percent. Optimum moisture content (Proctor density test) based on one sample is 10 percent, and the natural moisture content of 12 samples average about 12 percent; the dry bulk density of 12 samples from outcrops average about 129 pcf. Higher density (as much as 146.1 pcf) and lower moisture content (average 5.8 percent) for numerous samples from surface to 61.5 ft below surface; two cores tested for confined compression strength showed angles of internal friction of 35° and 63°.	Moderately difficult to difficult; pieces break as large cohesive masses; drilling slow, and holes will stand open without casing for several days.	Infiltration generally nil in undisturbed deposits; surface runoff rapid.	Easily eroded by water flowing in channels, but deposits erode slowly by sheet wash. Easily eroded where reworked and disturbed.	Generally very good if footings are kept dry.	The high density and dryness probably would result in reactions similar to nearby bedrock, but flowing, slumping, and fracturing should be expected near or along unconfined slopes where the material has been reworked and is wet.	Nil.	Generally stable when dry; unstable when wet.	High within 1,000 ft of base of mountain slopes.	Source of poor-quality embankment or fill material.
Glaciomarine deposits, second phase (Qms)	Hard cohesive compact dense diamicton; a heterogeneous mixture of gravel, sand, silt, and clay combined into a deposit that is predominantly a tightly bound gravel; sparse shell fragments; very weakly stratified. Radiocarbon date of 9,800±300 years B.P. was determined from shells.	Along shores of Gastineau Channel, Auke Lake, Auke Bay, and Fritz Cove; surface generally has mounds and elongate ridges that extend less than 200 ft above sea level in most places, although the Indian Cove deposit extends to about 300 ft.	From less than 20 ft to more than 55 ft.	Nonplastic; based on two samples from widely separated outcrops, the optimum moisture of both was about 6.5 percent; very hard; high dry density, two samples from different outcrops were 141.5 pcf and 142.0 pcf; these determinations are believed to be representative; contains about 3.0 percent natural moisture; high moisture retention; flows easily when wet; case hardens when dry.	Extremely difficult to excavate with heavy power equipment; drilling slow.	Infiltration very low on undisturbed deposits; surface runoff rapid.	Very low in natural state; resists sheet wash and gullying; easily eroded when disturbed.	Excellent when dry, extremely poor when wet.	Probably would react much like nearby bedrock when dry, but severe shaking of reworked and wet deposits would cause flowing, slumping, and fracturing.	Nil, except for lower part of ridge extending south from Salmon Creek.	Very stable when dry; very unstable when wet.	Nil.	Has been source of very poor quality embankment or fill material.
Glaciomarine deposits, third phase (Qme)	Cohesive compact diamicton; an unsorted and unstratified mixture of widely scattered pebbles, cobbles, and boulders in a matrix of sand, silt, and clay; contain scattered remains of vegetation and marine fossils; massive appearing, with an overall fine-grained texture. Age, from radiocarbon dates, ranges from 9,700 to 10,700 years B.P.	Generally below an altitude of 200 ft. Slope gently seaward or downvalley, paralleling surface on which deposited.	Variable; but generally less than 10 ft.	Principally sand, but high in clay and silt; liquid limit averages 21 percent and plasticity index less than 8 as determined for 12 samples; natural moisture content of 10 samples averages about 17 percent and dry bulk density of three samples averages 116.8 pcf. Deposit becomes very soft when wet.	Generally easily excavated and drilled; when saturated, has low bearing strength and platforms needed to support drilling equipment.	Infiltration practically nil; surface runoff moderately rapid.	Easily eroded by concentrated running water. Resists erosion by sheet wash in natural state, but easily eroded when reworked and loosened.	Poor to fair; deposit is generally thin, and firmer underlying deposits can be used.	Deposit is highly susceptible to shaking, fracturing, differential compaction and possibly minor sliding and flowing; large-scale sliding is unlikely.	Generally above expected heights of tsunamis and seiche waves; bluffs 10-15 ft high protect most of the deposits along channels and bays. Deposits at Auke Bay slope to water level and some inundation could be expected.	Slopes stand nearly vertically in cuts and excavations; stable when dry, but slumps and flows occur when wet.	High within 1,000 ft of the base of mountain slopes.	Might be a limited potential source of brick material.
Undifferentiated glaciomarine deposits (Qmu)	Not exposed but probably a cohesive, compact and heterogeneous mixture of sand, silt, clay, and gravel. Age is probably late Pleistocene or Holocene.	Mapped on the Mendenhall Peninsula, north of Auke Bay and Auke Lake, and in the Lena Cove area; extend upslope from the glaciomarine third phase deposits, and form relatively smooth surfaces bounding hillsides; mapped to an altitude of about 500 ft.		Unknown, but probably similar to either the glaciomarine first- or third-phase deposits.					Unknown, but probably would react similarly to either the glaciomarine first- or third-phase deposits.	Nil.	Unknown, but probably similar to that of either the glaciomarine first- or third-phase deposits.	Moderately high within 1,000 ft of the base of the mountain slope.	